COLLECTING A GROUNDWATER SCREENING SAMPLE

3.0 Groundwater Monitoring

3.1. Geology of the West Valley Site

3. 1. 1 Geologic History

At the northern border of Cattaraugus County in southwestern New York, the West Valley Demonstration Project is located on the well-dissected and glaciated Allegheny Plateau. The area is drained by Cattaraugus Creek, which is part of the Great Lakes – St. Lawrence watershed (Tesmer, 1975). Most of the geology affecting the site is the result of recent events in the earth's history, including repeated glaciation that occurred throughout the Pleistocene epoch 1.6 million to ten thousand years ago.

The WVDP rests immediately on a thick sequence of glacial deposits which range in thickness from 1.5 to 150 meters (5 to 500 ft.). These are underlain by an ancient bedrock valley consisting of upper Devonian shales and siltstones of the Canadaway and Conneaut Groups which dip southward at about 0.5° (Rickard, 1975). Total relief in the area is approximately 396 meters (1,300 ft.), with summits reaching 732 meters (2,400 ft.) above sea level.

Oscillations of the Laurentide ice sheet during the ice ages define four major stages of ice advance and retreat. The last one, of greatest concern here, was the Wisconsin stage (Broughton et al., 1966).

The lowermost glacial unit underlying the site, the Kent till, was deposited about 19,000 years ago, toward the end of the Wisconsin glaciation. At this time the ancestral Buttermilk Creek Valley was covered with ice. As the glacier began to recede, debris formerly trapped in the ice was left behind, impounding Buttermilk Creek Valley, which soon filled with melt water from the receding glacier, forming a temporary proglacial lake. As the ice continued to melt, more material washed out, filling the new lake with the lacrustrine and Kame Delta deposits that overlie the Kent till. Continued recession of the glacier ultimately led to drainage of the proglacial lake and exposure of its sediments to erosion (LaFleur, 1979).

Between 16,000 and 15,000 years ago the ice began its last advance (Albanese et al., 1984). Material from this advance covered the Kame Delta and lacustrine deposits with as much as 40 meters (130 ft.) of till. This newer unit, the Lavery till, is the uppermost unit throughout most of the site, with a thickness of 24 meters (80 ft.) at the waste burial areas. Its subsequent retreat left behind another proglacial lake which ultimately drained, allowing Buttermilk Creek to flow again. Postglacial alluvial fans were deposited on the western part of the Lavery till (beneath the plant area) bringing to a close the Pleistocene geology of the site (LaFleur, 1979).

3. 1. 2 Hydrogeology

The site can be divided into two regions: a north plateau on which the plant and its associated facilities reside, and a south plateau which contains the two waste burial areas. (See Figures 3-1 and 3-2).

The uppermost unit in the south plateau is the Lavery till, a very compact, gray silty clay with occasional pods of silt to fine sand. Below this is a sequence of more permeable lacustrine silt and sand, which in turn overlies the less permeable Kent till.

The north plateau differs from the south in that it has a 1- to 10- meter (3- to 30-ft.) sequence of alluvial sand and gravel that blankets the area and a 1- to 10-meter (3-to 30-ft.) till – sand sequence located in the Lavery till.

The depth to the groundwater on the north plateau varies from 0 to 5 meters (0 to 16 ft.), being deepest at the process building and intersecting the surface farther north towards the security fence. Most of the groundwater in the north plateau moves horizontally in the alluvial sand and gravel unit from an area southwest of the process building to the northeast, southeast, and east; minor amounts percolate downward to the underlying Lavery till. Discharge of north plateau groundwater occurs at seepage points along the banks of Frank's Creek, Erdman Brook, and Quarry Creek and at the wetlands near the northern perimeter of the security fence. Hydraulic conductivity of the alluvial sand and gravel unit averages 4.6×10^{-3} cm/sec (Bergeron et al., 1987).

The south plateau water table occurs in the upper 3 meters (0 to 10 feet) of the Lavery till. Groundwater flow in this unit is for the most part vertical, proceeding downward from overlying saturated

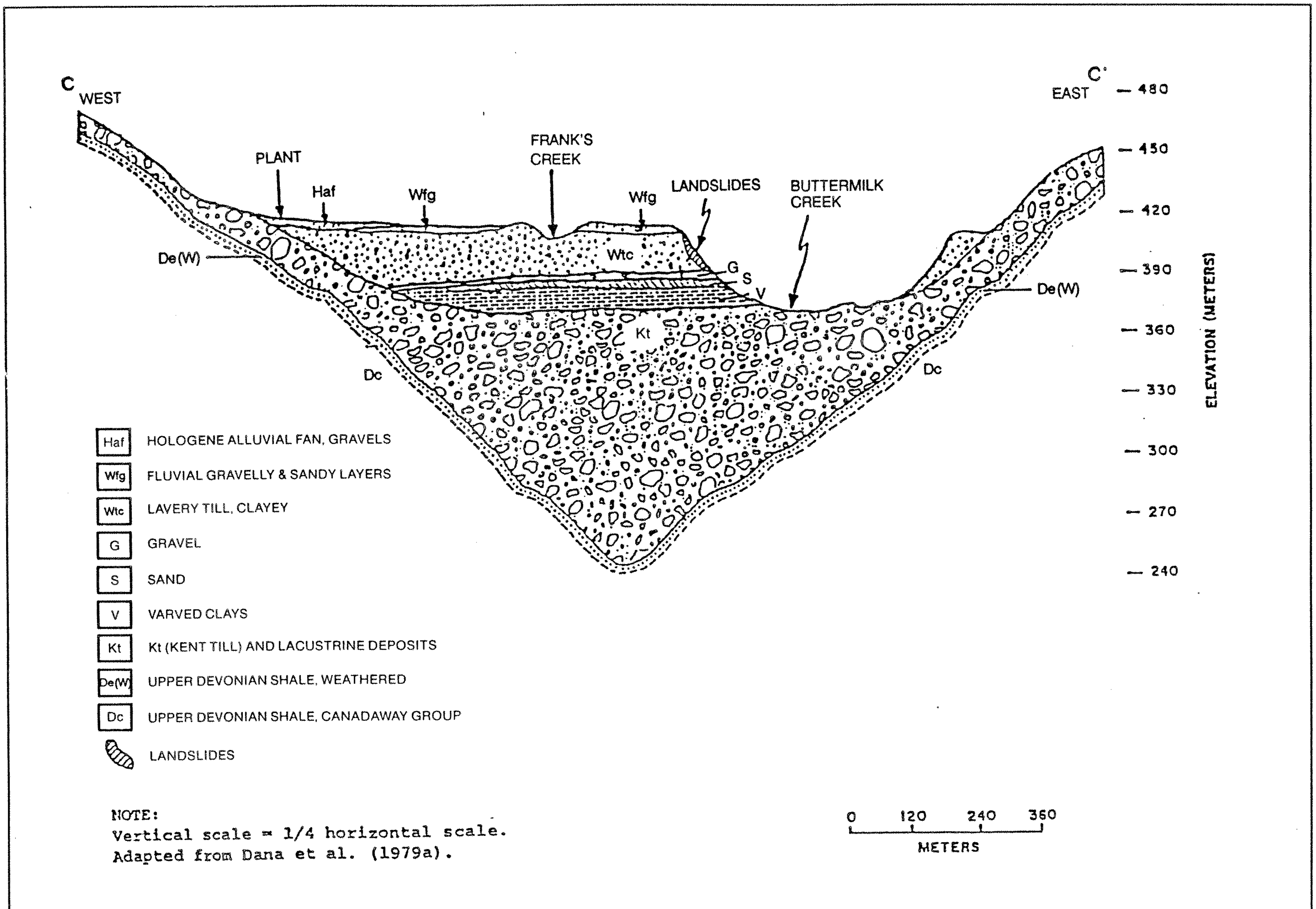


Figure 3-1. Geological Cross-Section Through the North Plateau.

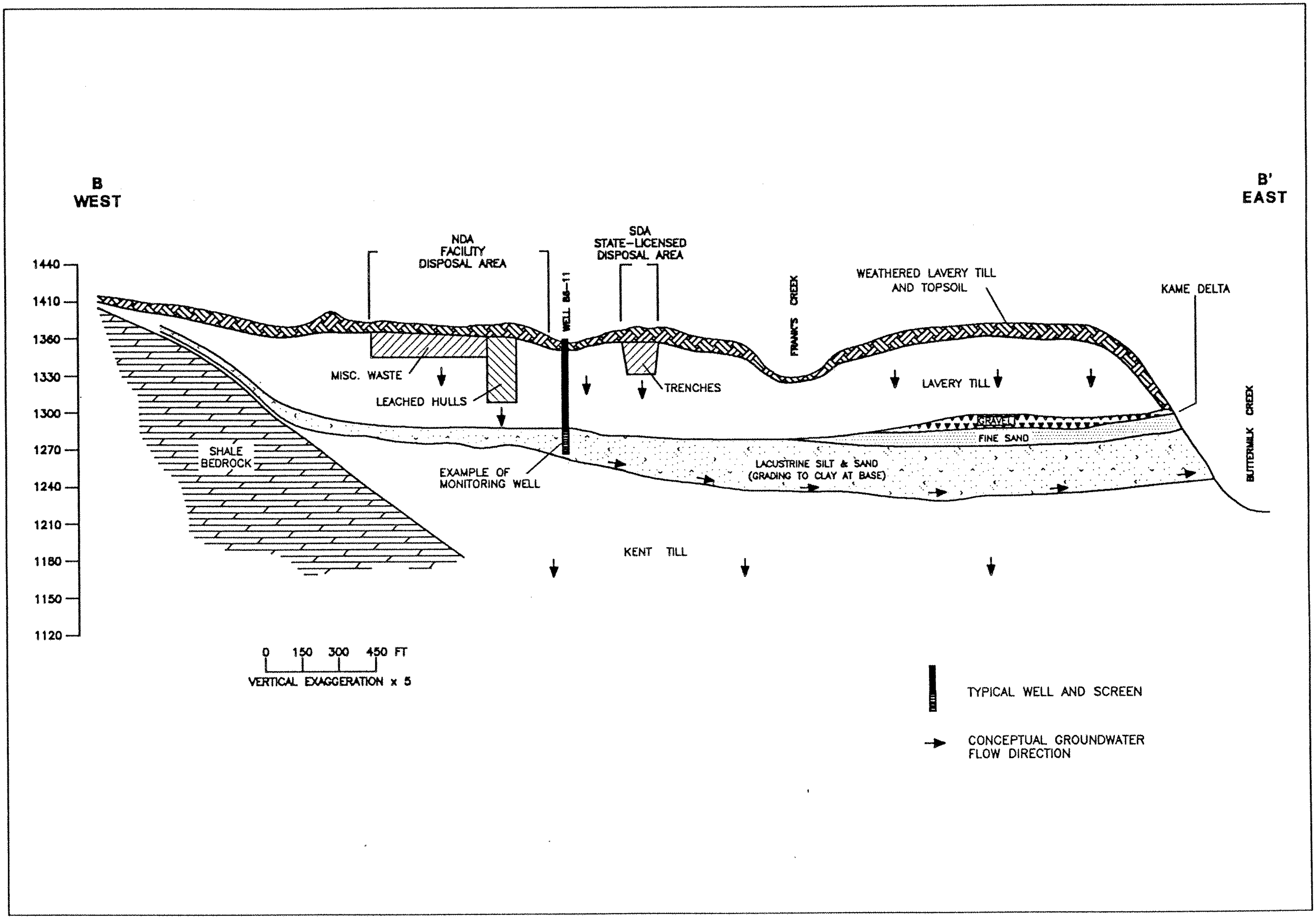


Figure 3-2. Geological Cross-Section Through the South Plateau.

layers to underlying unsaturated layers and ultimately to the lacustrine unit. The weathered portion of the Lavery does exhibit horizontal flow, which enables groundwater to move laterally before moving downward or discharging to local land-surface depressions or stream channels.(Bergeron and Bugliosi, 1988). Some laterally moving water eventually percolates downward to recharge the underlying unweathered till. Hydraulic conductivities in the weathered and unweathered Lavery till average 4.9 x 10^{-8} cm/sec and 2.8 x 10^{-8} cm/sec respectively (Bergeron et al., 1987).

The lacustrine silt and sand is a semiconfined aquifer which is recharged from the bedrock to the west. Water levels in piezometers completed in this unit suggest a small lateral flow gradient (23m/km) northeastward toward Buttermilk Creek. Minor recharge also occurs from the overlying Lavery till, making this unit a possible conduit of Lavery discharge to Buttermilk Creek. The lacustrine silt and sand unit is underlain by the Kent till (LaFleur, 1979).

3.2 Groundwater Monitoring Program Overview

The West Valley Demonstration Project's groundwater monitoring program for 1989 included two on-site programs: 1) monitoring three identified solid waste management units using statistical data analysis techniques to detect contamination; 2)monitoring older wells to maintain historical records (see Figure 3-3); and one off-site program monitoring off-site residential drinking water. (See Figure 3-4).

3. 2. 1 On-Site Waste Management Monitoring Network

A network of fourteen wells, a groundwater seep, and the outlet of a french drain monitored the three waste management units listed below for contaminant migration:

- the low-level radioactive waste lagoon system
- the high-level waste tank complex
- the NRC-licensed disposal area.

In each waste management unit one upgradient well, representative of background groundwater conditions, was monitored. Additional well sampling locations were in those downgradient areas most likely to intercept any groundwater contamination. Upgradient and downgradient locations were selected based upon groundwater flow patterns and proximity to any other potential sources of contamination.

Sample Collection

During 1989 eight separate samples were collected from each of the wells surrounding the three waste management units. Four samples were collected during the first half of the year and the remaining four samples were collected during the second half of the year. Before each semiannual sample collection, the depth to the water was measured using an electronic sounding device. A small volume of sample was also collected at the same time in order to evaluate the radiological conditions of the well water prior to sample collection. The sounding measurement was used, along with the total well depth and diameter, to calculate the total volume of standing water within the well casing.

At the time of sampling, three well casing volumes of water are pumped (purged) from each well before sample collection. (At least one well casing volume is removed if the well pumps dry). Purging effectively removes stagnant water from the well casing and draws fresh groundwater into the well so that a representative groundwater sample may be collected. After the well is adequately purged it is ready to be sampled. Table 3-1 lists the parameters for which samples are collected. Measurements of pH and specific conductivity, made at the beginning and end of the sampling, indicate the homogeneity of the sample collected.

Following collection from a given location, the samples are placed in a cooler for return to the site environmental laboratory where they are logged in and preserved. Samples to be analyzed by off-site laboratories are packaged and either delivered by laboratory personnel or shipped via overnight courier. Samples analyzed by on-site laboratories are held in controlled storage until time of analysis.

Table 3 - 1

Schedule of Groundwater Sampling and Analysis

Category	*Parameter*	*New York State Groundwater Quality Standard in mg/L*	*Comment*
I. EPA Interim Drinking Water Standards	Arsenic	0.025	Quarterly for first year; annually thereafter except coliform and pesticides
	Barium	1.0	
	Cadmium	0.01	
	Chromium	0.05	
	Fluoride	1.5	
	Lead	0.025	
	Mercury	0.002	
	Nitrate (as N)	10.0	
	Selenium	0.01	
	Silver	0.05	
	Gross Alpha	15.0 pCi/L	
	Gross Beta	1000 pCi/L 8 pCi/L Sr-90	
	Coliform bacteria		Not analyzed
	Endrin		
	Lindane		
	Methoxychlor		
	Radium		
	Toxaphene		
	2,4-D		
	2,4,5-TP Silvex		
II. Groundwater Quality Indicators	Chloride	250	Quarterly for first year; annually thereafter
	Iron	0.3	
	Manganese	0.3	
	Phenols	0.001	
	Sodium	<20	
	Sulfate	250	
III. Groundwater Contamination Indicators	Nitrate	10	
	pH	6.5-8.5	Four separate samples collected per semiannual period
	Conductivity	Not listed	
	Total Organic Carbon	Not listed	
	Total Organic Halogens	Not listed	
	Specific Metals	As above	
	Tritium	20,000 pCi/L	
	Gross Alpha	15 pCi/L	
	Gross Beta	1,000 pCi/L 8 pCi/L Sr-90	
	Specific Gamma Emitters	Not listed	
IV. Groundwater Elevations			Once before collecting each well sample

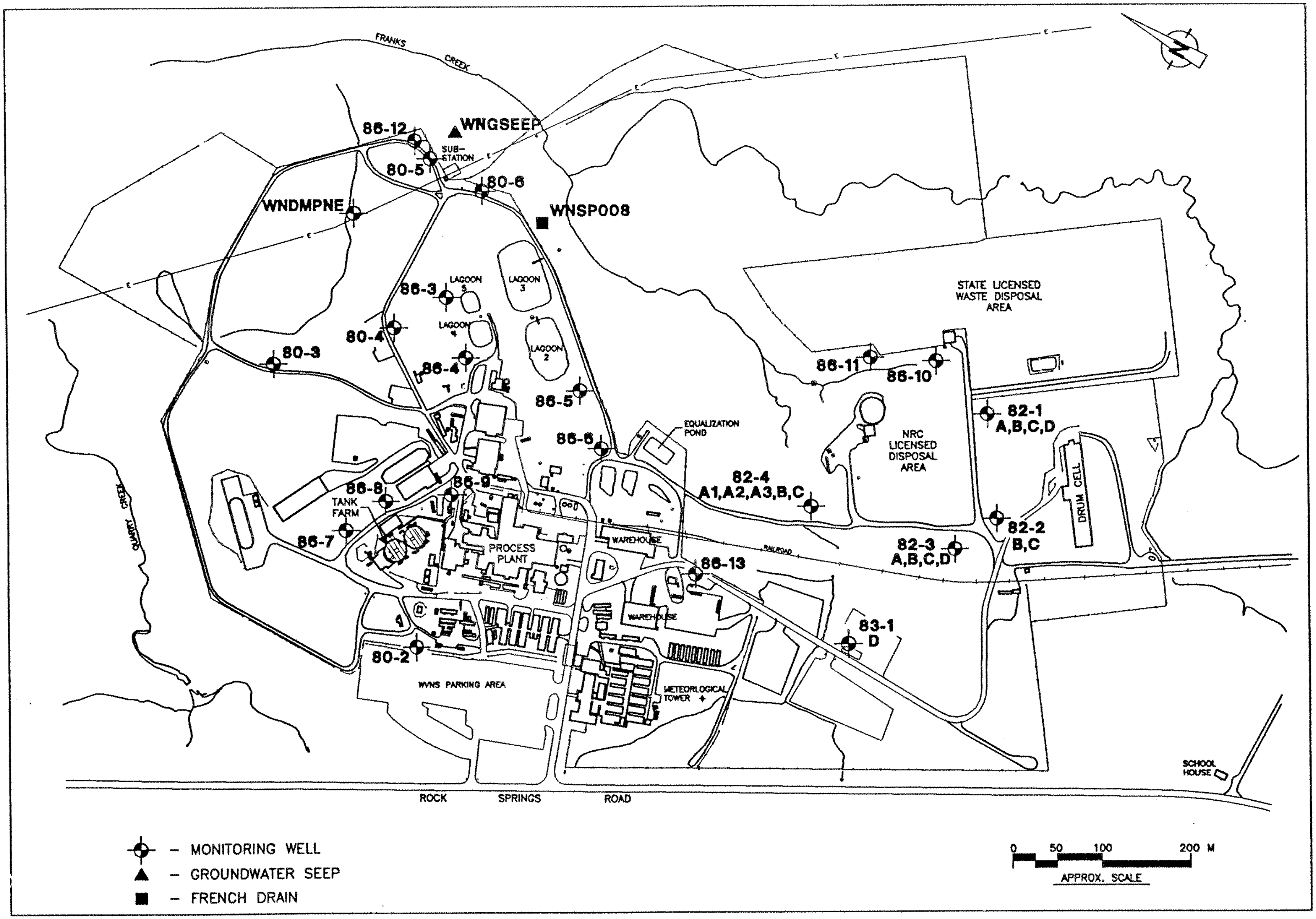


Figure 3-3. Location of On–Site Groundwater Monitoring Points.

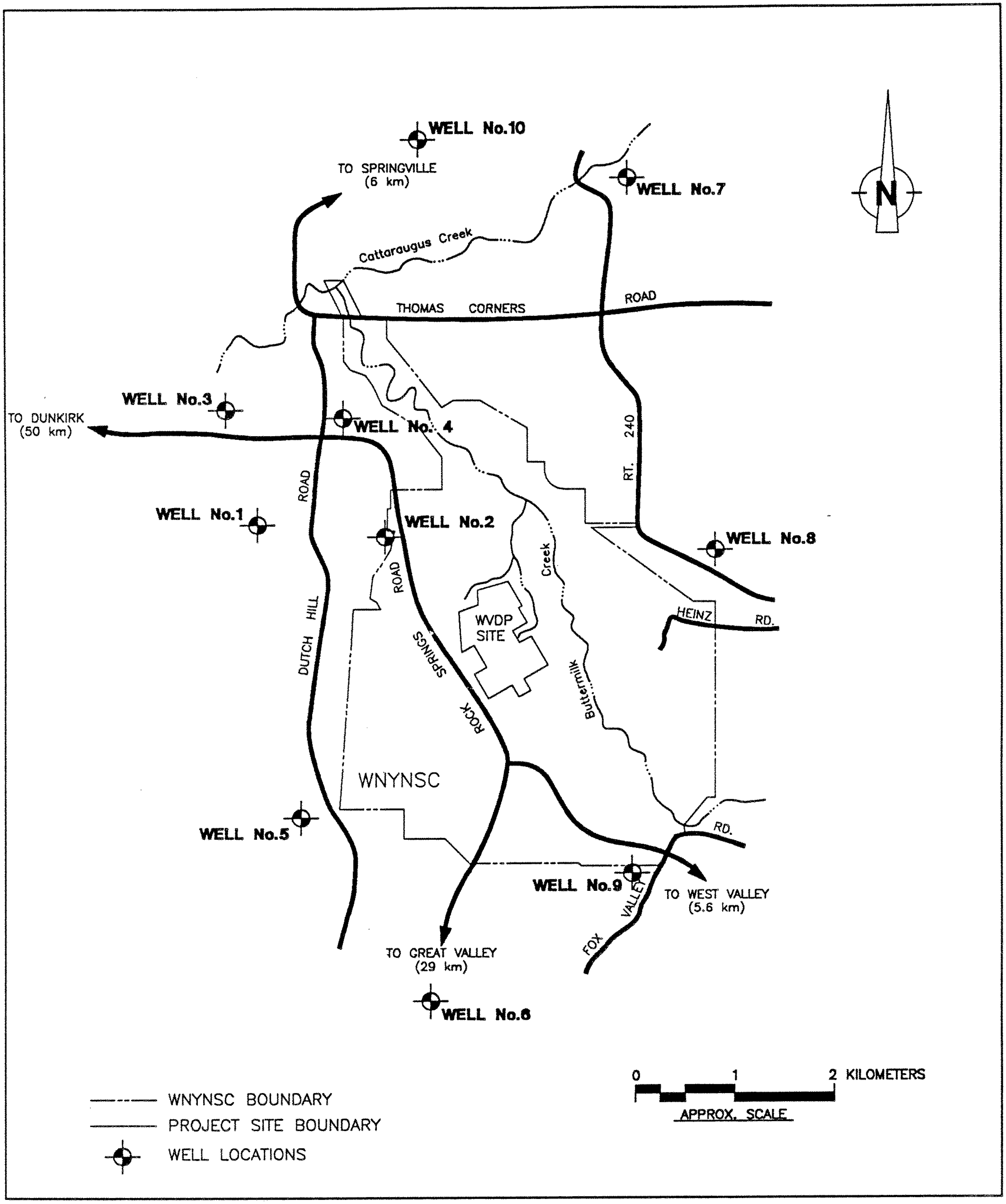


Figure 3-4. Location of Off-Site Groundwater Monitoring Points.

3. 2. 2 Waste Management Units

3.2.2.1 The Low-level Radioactive Waste Lagoon System

The low-level radioactive waste lagoon system is made up of four active lagoons, nos. 2, 3, 4, and 5, and an inactive lagoon, no.1, which has been filled. The active lagoons are currently used by the Project to treat low-level radioactive liquid waste and store treated water prior to discharge. The water is processed through the low-level waste treatment facility in batches.

Lagoons 1, 4, and 5 are constructed in the alluvial sand and gravel strata, and Lagoons 2 and 3 penetrate through these surficial deposits into the Lavery till (Bergeron et al., 1987). Both Lagoons 4 and 5 have synthetic membrane liners. The remaining lagoons are not lined with synthetic material. Mapping of groundwater elevations within this region (Bergeron et al., 1987) indicates that groundwater flows northeast and east.

A french drain was constructed around Lagoons 2 and 3 by the original operator of the reprocessing plant to minimize the amount of clean groundwater flow into Lagoons 2 and 3. The drain extends downward approximately to the top of the Lavery till and discharges on the southeast side of the road between Lagoon 3 and Erdman Brook. This french drain is also included on the site SPDES permit and is identified as location WNSP008.

Table 3-2 summarizes the locations of the wells used to monitor groundwater near the low-level radioactive lagoon system. (See also Figure 3-5).

3. 2. 2. 2 High-level Waste Tank Complex

The high-level waste tank complex includes the high-level waste tanks constructed by the former site operator and the supernatant treatment system constructed by the WVDP. The liquid high-level waste is stored in steel tanks contained in reinforced concrete vaults extending 40 feet below-grade into the Lavery till. The till – sand unit is absent beneath this complex.

The Supernatant Treatment System (STS)

The supernatant treatment system uses an ion exchange process to decontaminate liquid high-level waste. Facilities for this process are located below-grade in reinforced concrete structures and in above-grade buildings. The below-grade structures extend 20 feet below the surface and are located entirely within the alluvial sand and gravel unit.

Table 3-2

Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Wells

LOCATION CODE	WELL POSITION	WELL DEPTH (ft)*	ID (in)**	COMMENTS
WNW86-06	Upgradient	14.4	4	Upgradient well for lagoon system
WNW80-05	Downgradient	16.2	2	Monitors alluvial sand and gravel
WNW80-06	Downgradient	16.9	2	Monitors alluvial sand and gravel
WNW86-03	Downgradient	26.8	4	Monitors alluvial sand and gravel
WNW86-04	Downgradient	25.1	4	Monitors alluvial sand and gravel
WNW86-05	Downgradient	14.6	4	Monitors immediate vicinity of former Lagoon 1
WNGSEEP	Downgradient	N/A	N/A	Monitors surficial deposit seepage from North Plateau
WNSP008	Downgradient	N/A	N/A	Monitors outflow from french drain

*** Well depth measured from top of outer case. See Fig. 3-5 for sample locations. ** ID: Inside diameter**

The monitoring wells for this unit are located within the alluvial sand and gravel aquifer. One well, which is upgradient of the high-level waste tank complex, provides background information. The remaining three wells are downgradient from the facility. Two other remote downgradient locations that monitor the former nonradioactive construction and demolition debris landfill, the "cold" dump, which was closed 1986, are included in the report on this unit to allow comparison with background conditions.

The Construction and Demolition Debris Landfill

The construction and demolition debris landfill (CDDL), formerly the "cold dump," was used by Nuclear Fuel Services and the West Valley Nuclear Services Co. to dispose of nonradioactive construction debris and nonputrescible, nonhazardous trash. There is no record of disposal of hazardous materials in this facility; however, there is also no evidence of waste acceptance procedures that would exclude them. The landfill was closed in 1986 with the approval of the New York State Department of Environmental Conservation. Closure consisted of covering the landfill with compacted clay till.

The CDDL is underlain by the alluvial sand and gravel unit which is 10 to 15 feet thick. Flow in this unit is toward the north. The till – sand unit is not believed to extend beneath the landfill, and the depth of the lacustrine silt and sand deposits is believed to be about one hundred feet.

Table 3-3 provides information on groundwater monitoring locations of the supernatant treatment system and the landfill discussed above. (See also Figure 3-11)

3. 2. 2. 3 NRC-Licensed Disposal Area

The NRC-licensed disposal area (NDA) contains radioactive wastes which were generated by both Nuclear Fuel Services and the West Valley Demonstration Project. The wastes generated by NFS are contained in a horseshoe-shaped area which parallels the east, north, and west boundaries of the NDA. The wastes disposed of by the WVDP are in the parcel of land contained within the horseshoe. The Lavery till is encountered at the surface of the south plateau where the NDA is located. The alluvial sand and gravel aquifer, which blankets much of the north plateau, is not in the vicinity of the NDA.The deeper aquifer unit beneath the NDA is the lacustrine silt and sand deposit, 70 to 100 feet below the surface. This unit is at least 30 feet below the deepest known disposal in the NDA and is separated from the waste by the unweathered Lavery till. From the minimal data available regarding this unit, Bergeron (1987) hypothesized that groundwater flow in the lacustrine silt and sand deposit was toward the north – northeast.

Table 3- 3

High-Level Waste Tank Complex Groundwater Monitoring Locations (including CDDL Wells)

LOCATION CODE	WELL POSITION	WELL DEPTH* (ft)	ID (in)**	COMMENTS
WNW80-02	Upgradient	16.6	2	Upgradient well for High-level Waste Tank Complex
WNW86-07	Downgradient	20.1	4	Monitors alluvial sand and gravel
WNW86-08	Downgradient	20.1	4	Monitors alluvial sand and gravel
WNW86-09	Downgradient	27.9	4	Monitors alluvial sand and gravel
WNW86-12	Downgradient	20.1	4	Monitors alluvial sand and gravel
WNDMPNE	Downgradient	7.8	8	Monitors surficial drainage near CDDL (former "Cold Dump")

*** Well depth measured from top of outer case. See Fig. 3-11 for sample locations. ** ID: Inside diameter**

The NDA was used by Nuclear Fuel Services for disposing of radioactive wastes other than the high-level liquid radioactive waste generated by reprocessing operations. The wastes included leached fuel assembly hulls and ends, sludges, resins, filter media from air and water treatment systems, spent solvents (sorbed onto solid material), discarded vessels, and piping and miscellaneous trash. It is believed that NFS also buried some damaged hardware possibly containing spent fuel in this facility.

The WVDP also disposed of wastes that had been generated by maintenance of the plant in the safe-shutdown-condition while high-level waste solidification progressed. Disposal of WVDP waste in the NDA stopped in 1986.

Hazardous and/or radioactive mixed-waste also may have been disposed of in this facility although there is no record of such disposals. At a minimum these wastes might include liquid scintillation vials, other laboratory wastes, and elemental lead used for shielding or shielded disposal containers. There are records of disposals of lead shielding by the WVDP in this facility. However, at the time of disposal this shielding, which was part of the waste disposal package, was not classified as waste by Department of Energy policy.

Groundwater monitoring locations for this solid waste management unit are located in the lacustrine silt and sand deposits. Table 3-4 describes the wells within this unit. (See also Figure 3-14).

3.2.3 On-Site Supporting Well Monitoring

In addition to the wells described above, many other wells (WNW80 and WNW82 series) are sampled on a semiannual basis primarily to update historical data. Parameters monitored on samples from these wells include gross radiological constituents, tritium, isotopic gamma emitters, pH, and conductivity. The wells were installed to obtain water level measurements and may be deleted from the sampling program as new wells, constructed specifically for groundwater sampling, are brought on line.The below-ground gasoline and diesel fuel storage area is monitored by well WNW86-13. Samples collected from this location are monitored for selected volatile organic compounds (benzene, toluene, and xylenes) which would indicate fuel leakage. Other selected water quality parameters and radioactivity are also monitored at this location.

Table 3-5 describes the wells in the supporting groundwater monitoring program.

3.3 Groundwater Monitoring Results

3.3.1 Statistical Treatment of Groundwater Data

Groundwater Contamination Indicator Data

Site-induced contamination of groundwater may be indicated when differences are observed between waste management unit wells located hydraulically upgradient and downgradient. Typically, pH, conductivity, total organic carbon, and total organic halogens are used as indicators of contamination.

Table 3-4

NRC-Licensed Disposal Area Groundwater Monitoring Locations

LOCATION CODE	WELL POSITION	WELL DEPTH (ft) *	ID (in)**	COMMENTS
WNW83-1D	Upgradient	56.0	2	Upgradient well for NRC-Licensed Disposal Area
WNW82-1D	Downgradient	99.9	2	Monitors lacustrine silt and sand - Dry Well
WNW86-10	Downgradient	117.0	2	Monitors lacustrine silt and sand
WNW86-11	Downgradient	117.0	2	Monitors lacustrine silt and sand

*** Well depth measured from top of outer case. See Fig. 3-14 for sample locations. **ID: Inside diameter**

Table 3- 5

Supporting Groundwater Monitoring Locations

LOCATION CODE	WELL DEPTH (ft)*	ID (in)**	COMMENTS
WNW80-03	8.0	2	Monitors alluvial sand and gravel of North Plateau
WNW80-04	12.8	2	Monitors alluvial sand and gravel of North Plateau
WNW82-1A	20.3	1	Monitors Lavery Till of South Plateau
WNW82-1B	31.0	1	Monitors Lavery Till of South Plateau
WNW82-1C	52.8	1	Monitors Lavery Till of South Plateau
WNW82-2B	41.0	1	Monitors Lavery Till of South Plateau
WNW82-2C	52.1	1	Monitors Lavery Till of South Plateau
WNW82-3A	20.5	1	Monitors Lavery Till of South Plateau
WNW82-4A1	16.5	0.7	Monitors Lavery Till of South Plateau
WNW82-4A2	17.0	0.7	Monitors Lavery Till of South Plateau
WNW82-4A3	18.2	0.7	Monitors Lavery Till of South Plateau
WNW86-13	11.9	4	Monitors petroleum fuel storage area

*** Well depth measured from top of outer case. ** ID: Inside diameter**

At the West Valley Demonstration Project, radiological site-specific parameters are included in the groundwater indicators list shown in Table 3-1. The radiological measurements are most likely to be the more sensitive of the indicator parameters listed. Tritium, being an integral part of the water molecule itself, serves as a very early and sensitive contamination indicator.

Eight independent samples were collected for each of the indicator parameters from each well in the waste management unit monitoring program. These indicator data were treated with the Analysis of Variance statistical technique (ANOVA). The ANOVA method compares mean concentrations of a given parameter for samples collected at different monitoring locations. This comparison determines if statistically significant differences exist between well data within the same waste management unit. If significant differences are determined, statistical contrast procedures are used to evaluate which location(s) are different.

Any differences indicated by the ANOVA method may reflect either positive or negative differences with respect to the upgradient well location. Negative differences are cause for concern only with the pH indicator parameter. Negative differences for the other indicator parameters (lower concentrations at downgradient locations compared to upgradient locations) are not considered indicators of contamination.

The ANOVA is a recommended statistical method for evaluating statistical differences between upgradient and downgradient groundwater data (USEPA, 1989). It is important to note, however, that significant differences do not imply a rising or falling trend within a given well, but rather that the well has a significantly different concentration than the upgradient well.

Tabular Presentation of Results

Appendix E provides tables of all data collected for the routine groundwater monitoring program during 1989. All waste management unit groundwater data were obtained from the collection of four independent samples in each semiannual period.

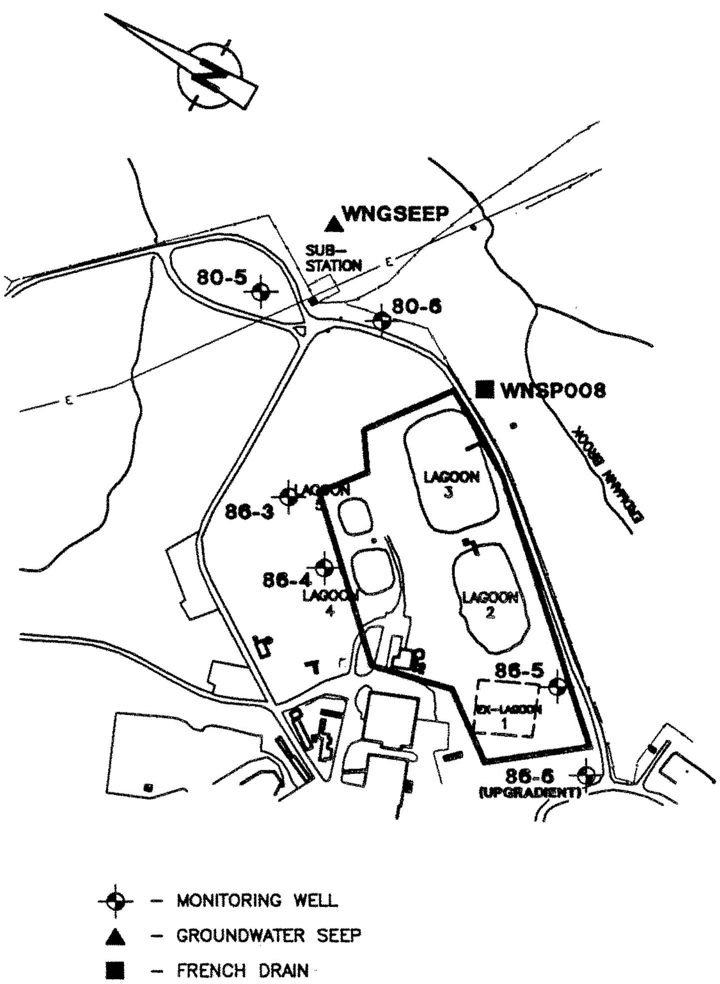
Table 3-6

Summary of Groundwater Monitoring Data for the Low-Level Radioactive Lagoon System Unit

STATISTICAL DIFFERENCES OBSERVED AT DOWNGRADIENT WELLS COMPARED TO UPGRADIENT WELL WNW86-6

Parameter	WNGSEEP	WNSP008	WNW80-05	WNW80-06	WNW86-03	WNW86-04	WNW86-05
pH	lower	-	-	lower	higher	higher	-
Conductivity	-	-	-	-	-	-	-
TOC	-	-	-	-	-	-	higher
TOX	-	-	-	-	-	-	-
Tritium	higher	higher	higher	higher	higher	higher	higher
Gross Alpha	-	-	-	-	-	-	higher
Gross Beta	-	higher	-	-	-	higher	higher
Nitrate-N	higher	higher	higher	-	higher	higher	-

Note: For pH, "lower" indicates results lower than the upgradient well. For all parameters, "higher" indicates results higher than the upgradient well.



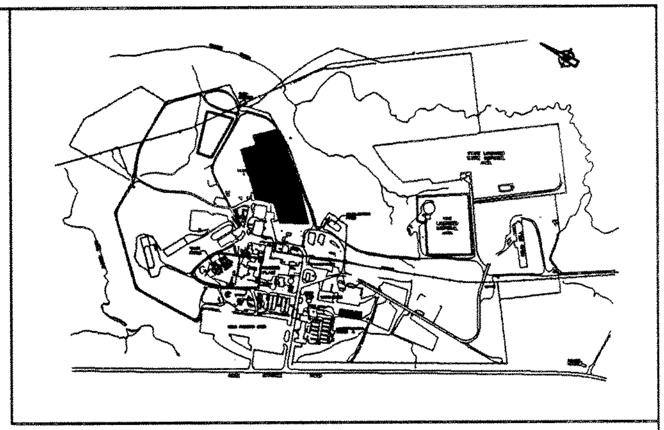
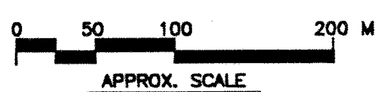


Figure 3-5. Locations of Groundwater Monitoring Points for the Low-Level Radioactive Lagoon System Unit.



3.3.2 Low-level Radioactive Waste Lagoon System

Table 3-6 summarizes the statistically significant differences observed between upgradient and downgradient wells within the low-level radioactive waste lagoon system for the groundwater contamination indicator parameters as described above in Section 3.3.1. (See Figure 3-5 for locations of wells within this unit).

Several items within Table 3-6 are noteworthy. Tritium concentrations at all downgradient locations are significantly greater than at upgradient well WNW86-06. Also, gross beta activity compared to upgradient concentrations was shown to be significantly elevated at several locations The areal extent of gross beta contamination, however, is more limited when compared to the areal extent for tritium.

Both cesium-137 and cobalt-60 are potential site contaminants because they are part of the nuclear fuel cycle. These isotopes are found in the liquid high-level waste in substantial amounts. Neither cesium-137 nor cobalt-60, both gamma-emitting radionuclides, were detected in any of the groundwater samples collected from any of the routinely monitored groundwater locations.

Table 3-6 also indicates that several chemical indicator parameters (pH, nitrate, and total organic carbon) are significantly different at downgradient monitoring locations.

Figure 3- 6

Averaged 1989 Tritium Concentrations (μCi/mL) for Wells Monitoring the Low-Level Radioactive Lagoon System Unit. (Note log scale).

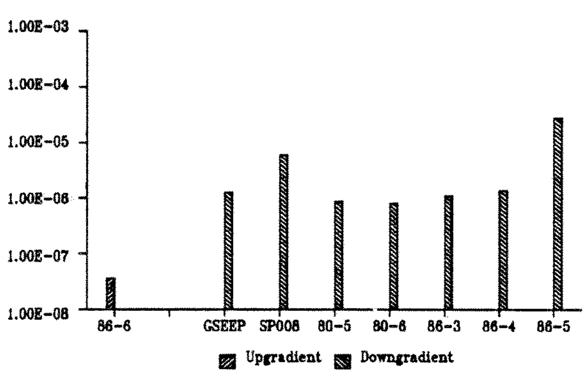
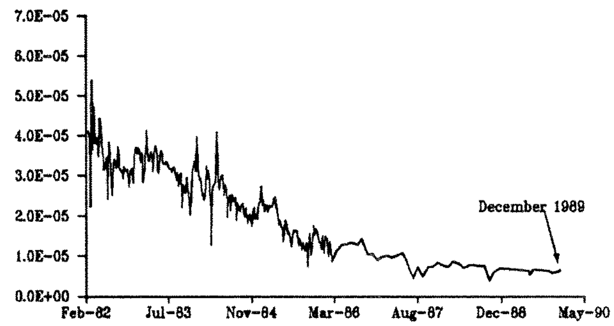


Figure 3 - 7

Tritium Concentrations (μCi/mL)1982 - 1989 at the Low-level Radioactive Lagoon System Unit. Monitoring point is WNSP008.



Analysis of contamination indicator data suggests that groundwater contamination has occurred around the immediate vicinity of the low-level radioactive waste lagoon system. These findings are, however, consistent with past evaluations (WVNS, 1988; Marchetti, 1982) which have indicated levels of radioactivity in groundwater above natural background levels. Figure 3-6 shows in graphic form a comparison of averaged tritium concentrations measured during 1989 for all wells within the low-level radioactive waste lagoon system. As the figure indicates, there are obvious differences between groundwater monitoring locations. (Note that the Y-axis in Figure 3-6 is presented with a logarithmic scale). In addition to Figure 3-6, Figure 3-7 provides results for long-term measurements of tritium made at one location, the french drain (WNSP008). This line graph indicates that tritium concentrations have decreased substantially since 1982. However, concentrations are still elevated compared to background.

Figure 3-8 is a bar graph of averaged gross beta activity for wells within the low-level radioactive waste lagoon system monitoring unit. As with the tritium bar graph, the Y-axis is presented on a logarithmic scale. The locations which show the most elevated tritium concentrations also show the most elevated gross beta concentrations. In both cases, locations WNW86-05 and WNSP008 are more greatly elevated than the remaining downgradient locations.

Figure 3- 8

Averaged 1989 Gross Beta Concentration (μCi/mL) for Wells Monitoring the Low-Level Radioactive Lagoon System. (Note log scale).

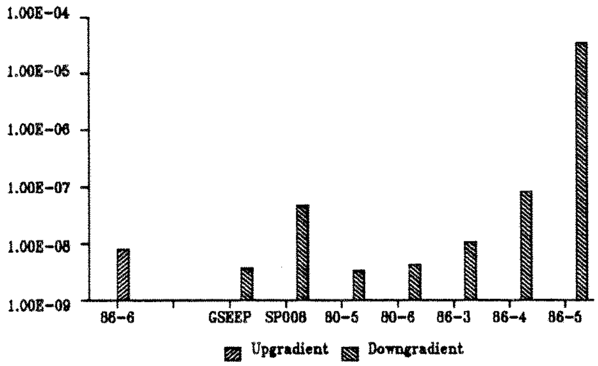
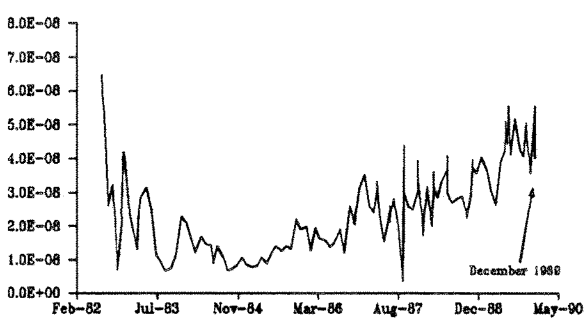


Figure 3-9 shows the results of long-term measurements of gross beta activity made at the french drain (WNSP008). These data do not show the same declining trend as noted for the tritium data collected from this location.

Well WNW86-05 shows the highest levels of tritium and gross beta activity for any of the wells routinely monitored on-site. Well WNW86-05 is located at the downgradient edge of former Lagoon 1 (See Figure 3-5). Figure 3-10 shows the complete history of tritium and gross beta monitoring since the initial sampling of this well in December 1986. As indicated, tritium concentrations have remained relatively constant over the period that this well has been monitored. Concentrations of gross beta activity also appear relatively constant; however, the data tend to suggest a slight upward trend over time.

Figure 3-9.

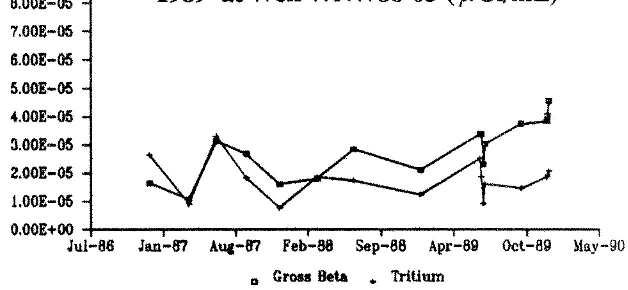
Gross Beta Concentrations(μCi/mL) from 1982-1989 at the Low-Level Radioactive Lagoon Monitoring Point WNSP008



Well WNW86-05 is currently the only routinely monitored waste management unit well which exceeds the DOE's DCG limit for radioactivity. Gross beta levels (3.5E-05 μCi/L!) exceed upgradient background concentrations (gross beta = 8.0E-09 μCi/mL at upgradient well WNW86-06) by about 4,500-fold. The Sr-90 DCG limit (1.0E-06 μCi/mL) is exceeded by approximately 35-fold. The Sr-90 DCG limit is used for comparison to gross beta concentrations because it is most likely to be the site's beta contaminant. Note that tritium concentrations are elevated by about 175-fold when compared to upgradient background. However, the tritium concentrations at this location are still well below the DCG level of 2E-03 μCi/mL.

Figure 3-10

Tritium and Gross Beta from 1986-1989 at Well WNW86-05 (μCi/mL)



3.3.3 High-level Radioactive Waste Tank Complex

Table 3-7 is the statistical summary table for contamination indicator parameters for the high-level waste tank complex and former cold dump. Although the CDDL is not part of the high-level waste tank complex it is included in the table for comparison to background conditions at upgradient well WNW80-02. (See Figure 3-11, which shows the locations of these groundwater monitoring locations).

For the wells monitoring the high-level waste area, only well WNW86-09 shows significantly elevated levels of tritium when compared to site upgradient well WNW80-02. In past years, well WNW86-08 has also shown elevated levels of tritium; however, during 1989 tritium levels declined at this location. Four out of the eight samples collected at this loca-

Table 3- 7

Summary of Groundwater Monitoring Data for the High-Level Radioactive Waste Tank Complex and Cold Dump

STATISTICAL DIFFERENCES OBSERVED AT DOWNGRADIENT WELLS COMPARED TO UPGRADIENT WELL WNW80-02

Parameter	WNW86-7	WNW86-8	WNW86-9	WNW86-12*	WNDMPNE*
pH	lower	lower	lower	-	lower
Conductivity	higher	higher	higher	higher	higher
TOC	-	higher	higher	-	higher
TOX	-	-	-	-	-
Tritium	-	-	higher	higher	-
Gross Alpha	-	-	-	-	-
Gross Beta	higher	higher	higher	-	higher
Nitrate-N	higher	-	higher	-	-

Note: For pH, "lower" indicates decrease. For all parameters, "higher" indicates increase.

*** Monitoring wells near former Cold Dump.**

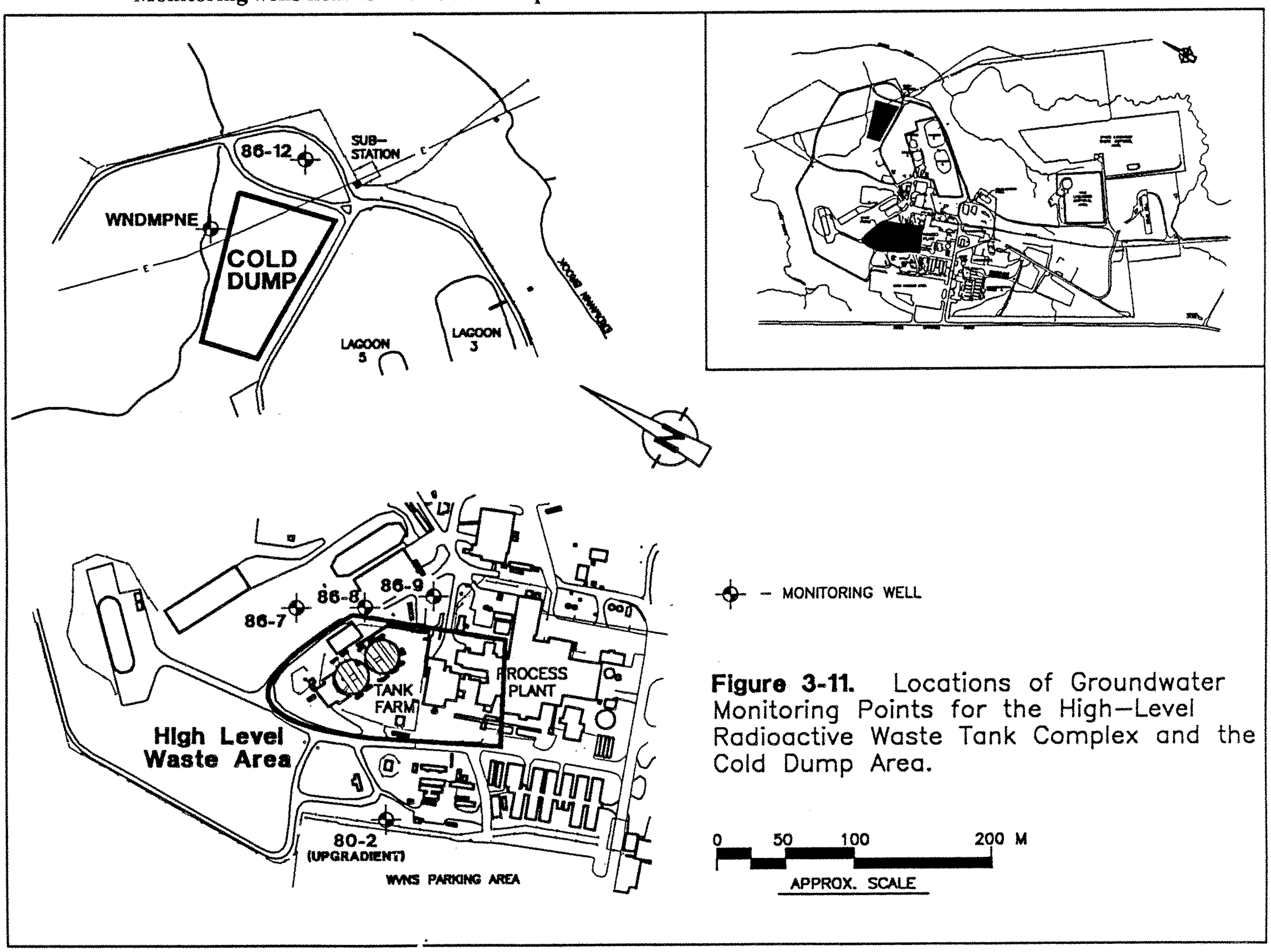
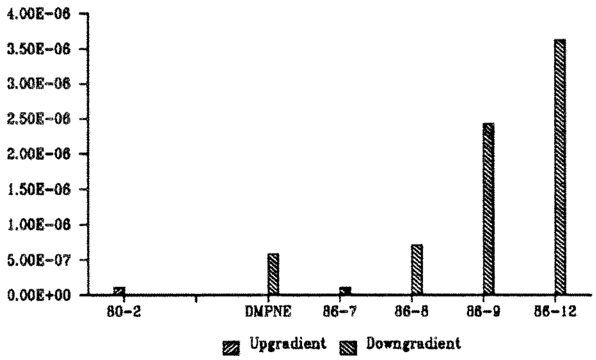


Figure 3-11. Locations of Groundwater Monitoring Points for the High-Level Radioactive Waste Tank Complex and the Cold Dump Area.

Figure 3-12.

Averaged 1989 Tritium Concentrations (μCi/mL) for Wells Monitoring the High-Level Radioactive Waste Tank Complex and CDDL.



tion were less than the detection limit of 1E-7 μCi/mL for tritium. Elevated levels of gross beta activity continue to be more widespread, as indicated in Table 3-7.

For the two locations monitoring the CDDL (WNW86-12 and WNDMPNE), tritium was elevated at well WNW86-12, and gross beta was elevated at location WNDMPNE. These observations are consistent with past findings for 1987 through 1988 (WVNS, 1988).

Figures 3-12 and 3-13 are bar graphs illustrating the averaged concentrations of tritium and gross beta for wells monitoring the high-level waste tank complex and CDDL. These figures provide visual comparisons of concentrations for these important groundwater monitoring parameters. The radiological data suggest that although differences exist between upgradient and downgradient locations, the differences do not reflect leakage from the tanks containing the high-level radioactive waste. The observed differences noted are similar to past findings and may be attributable to soil and water contamination from past operations of the facility. Further, monitoring in the immediate vicinity of the high-level waste tanks continues to validate their integrity. Table 3-7 also shows that for the wells that monitor these two waste management units, significant differences between upgradient and downgradient locations were observed for chemical contamination indicator parameters. The pH and conductivity results indicate lower levels of pH for all wells except WNW86-12, and higher levels of conductivity for all downgradient wells. It is not known if these changes are directly attributable to activities at the site, but these observations are consistent with past findings in this area (WVNS, 1988).

3. 3. 4 NRC-Licensed Disposal Area Monitoring Unit

Table 3-8 presents summary statistics for the contamination indicator parameters monitored in the NRC- licensed disposal area. As the table indicates, only minor differences between upgradient and downgradient locations were observed. The fact that tritium concentrations at these three locations are at background levels and show no significant differences between locations provides reassuring evidence that groundwater contamination has not occurred in the lacustrine silt and sand deposits. These conclusions are consistent with past observations in this area. Figure 3-14 shows the locations of wells monitoring this unit.

Although lacustrine deposit contamination is not suspected, the NDA area is currently undergoing significant remediation. In 1983 the migration of radiologically contaminated organic solvent was observed in the weathered Lavery till in relatively shallow wells (82-series) that monitored the northeast sector of the NDA area. Efforts continue to remediate and check the migration of organic and radiological contamination from this area into adjacent surface waters. Section 2.6 of this report

Figure 3-13.

Averaged 1989 Gross Beta Concentrations (μCi/mL) for Wells Monitoring the High-Level Radioactive Waste Tank Complex and CDDL.

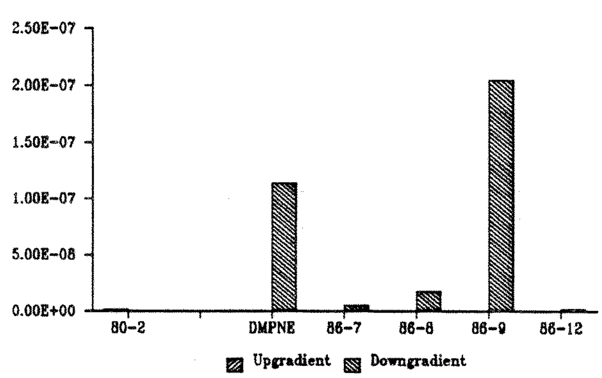


Table 3-8

Summary of Groundwater Monitoring Data for the NRC-Licensed Disposal Area

STATISTICAL DIFFERENCES OBSERVED AT DOWNGRADIENT WELLS COMPARED TO UPGRADIENT WELL WNW83-1D

Parameter	WNW86-10	WNW86-11	WNW82-1D
pH	higher	-	dry
Conductivity	higher	higher	dry
TOC	-	-	dry
TOX	-	-	dry
Tritium	-	-	dry
Gross Alpha	-	-	dry
Gross Beta	higher	-	dry
Nitrate-N	-	-	dry

For ph,"lower" indicates decrease. For all parameters,"higher" indicates increase.

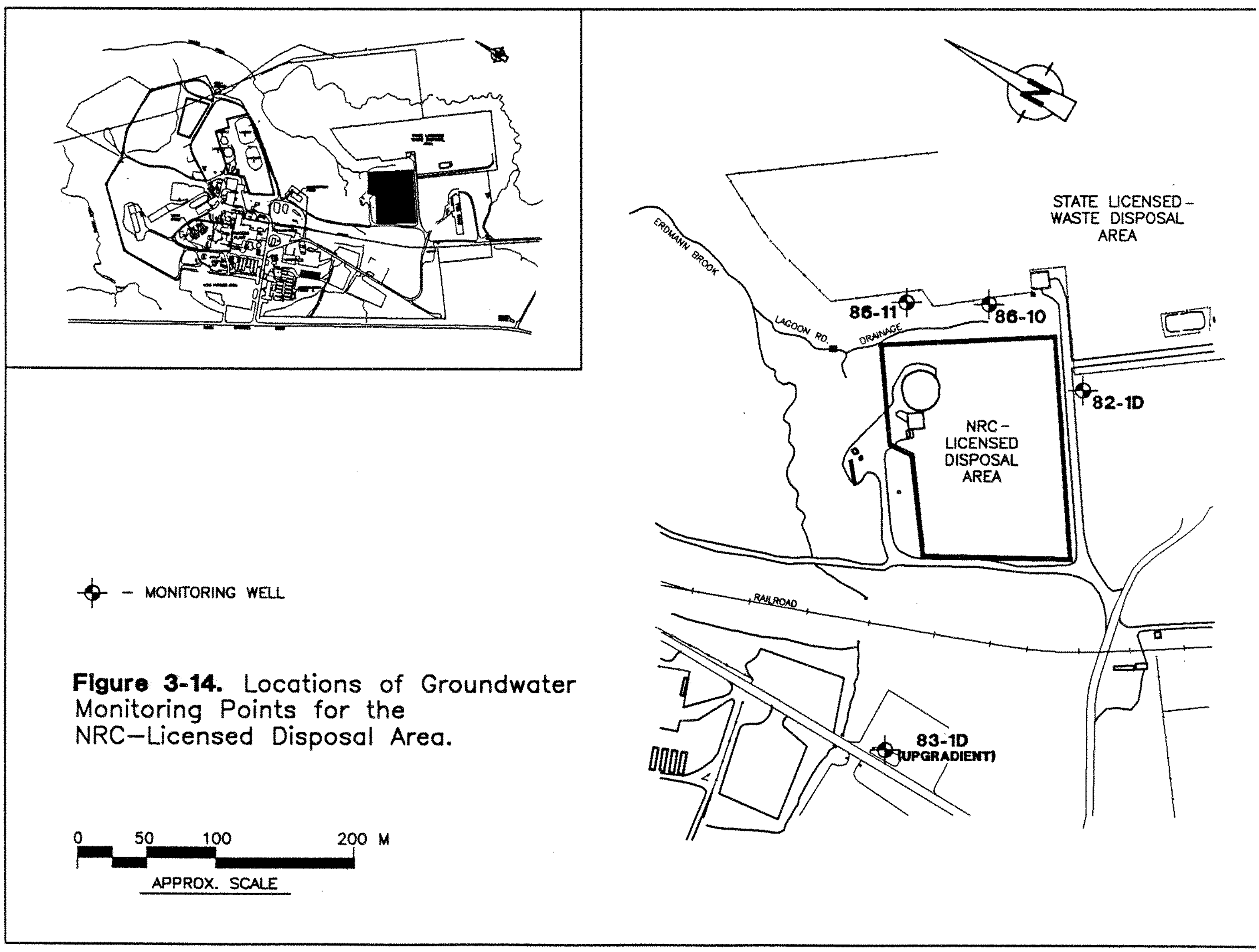


Figure 3-14. Locations of Groundwater Monitoring Points for the NRC–Licensed Disposal Area.

describes some special sampling, carried out during December of 1989 in the immediate vicinity of the organic migration area, that focused on shallow wells within the weathered Lavery till.

3.3.5 Significance of Waste Management Unit Monitoring

The above discussions address specific groundwater monitoring carried out during 1989 around waste management units. Statistical comparisons between upgradient and downgradient wells help determine whether groundwater contamination has occurred around the monitored units.

Sufficient evidence exists to suggest that groundwater surrounding the low-level radioactive waste lagoon system, the high-level radioactive waste tank complex, and the CDDL has been affected by operations at the site.

Within the low-level radioactive waste lagoon system the greatest impacts have been observed nearest the actual lagoons. This is indicated by Figures 3-6 and 3-8 which show the highest levels of contamination at the downgradient edge of former Lagoon 1 (well WNW86-05) and at the french drain (WNSP008). The long term trends for radiological activity at WNSP008 indicate that tritium activity (Figure 3-7) has declined substantially during the past eight years. It was noted, however, that gross beta activity (Figure 3-8) has not shown this decreasing trend. Figure 3-10 presents trend data for tritium and gross beta activity at well WNW86-05. This plot indicates that tritium concentrations have remained relatively stable and that gross beta levels are relatively stable or increasing slightly with time.

Results for the high-level radioactive waste tank complex indicate that groundwater quality within this unit has been affected by site activities. However, because of the levels and nature of the contamination, these effects appear unrelated to the actual storage of the liquid high-level waste. It is likely that the radiological and chemical differences noted between upgradient and downgradient locations are the result of previous operations of the reprocessing facility and possible subsurface changes influenced by construction activity.

Groundwater monitoring results for the NRC–licensed disposal area do not suggest any real impacts to the lacustrine silt and sand deposits. This conclusion is based upon the lack of significant differences between upgradient and downgradient locations, most notably with respect to tritium. It must be added, however, that continued remediation occurs within the actual disposal unit to control the migration of radiologically contaminated organic solvent within the Lavery till.

3. 3. 6 Other Supporting Wells Monitored On-Site

Supporting wells monitored on the site include those wells which are not part of the waste management unit monitoring program. These wells, which are monitored semiannually, were installed primarily to measure groundwater elevations and may be phased out of service as new groundwater monitoring wells are brought on-line. Data resulting from sample collection (shown in Appendix E,Table E-1) are generally consistent with past observations from these wells. The continued detection of elevated levels of tritium in well WNW82-4A1 appears to be of greatest significance. Tritium concentrations in this well are approximately 400-fold greater than in adjacent wells WNW82-4A2 and WNW82-4A3. All three wells are located in a straight line at approximately the same depth and are separated by about 19 feet (See Table 3-5). It was observed during installation of well WNW82-4A1 that the well boring was drilled into a filled excavation created by NFS to make a ramp to dispose of a large dissolver into Special Hole (SH) 9 in the then-active NRC-licensed disposal area. Wells WNW82-4A2 and WNW82-4A3 were installed after well WNW82-4A1. Tritium concentrations from these latter two wells are substantially lower than values observed in well WNW82-4A1. It is believed that groundwater flow from this previously excavated area is not of sufficient volume to affect surface water; however, additional wells have been located downgradient of this area to provide additional monitoring.

Of additional significance is the continued detection of gross beta concentrations in the low E-07 μCi/mL range at well WNW80-03, levels that have been observed at this location for several years. The cause for the elevated levels in this shallow well is not fully understood. The well is downgradient of a former contaminated hardstand area and also downgradient of the main plant facilities. The fact that tritium concentrations at this location are low suggests that the detected beta activity may stem from localized surface soil contamination, mobilized by surface water flow.

In addition to the routine sampling of the above supporting wells, all active site wells and several older wells were sampled for the presence of volatile organic compounds during 1989. This special sampling was undertaken because of a continuing increased awareness of the proper management of chemical constituents as well as radiological materials. Analysis of these samples included full GC/MS analysis for either the hazardous substance list or RCRA Appendix IX of 40 CFR Part 264 list of volatile organic compounds.

The results of sampling for volatile compounds revealed that three wells contained 1,1-dichloroethane at levels greater than the analytical detection limit of 5 μg/L (ppb). Wells WNW86-09, WNWN-1 (both near the high-level radioactive waste tank complex), and well WNW86-12 (near the CDDL) exhibited concentrations ranging between 6.5 and 18.5 μg/L. These values marginally exceed the New York State groundwater quality standards for class GA waters. (See section 3.3.8 below).

At this time there appears to be no direct hydraulic connection between the 1,1-dichloroethane detected in the two separate locations. In addition, the lack of positive results above the analytical detection limit for all of the other wells sampled suggests that this contamination is not widespread through the site. Upon completion of follow-up confirmatory sampling in 1989, the WVDP notified the New York State Department of Environmental Conservation about the findings relative to 1,1-dichloroethane. The origin of this compound is not yet understood. The expansion of the Project's groundwater monitoring program during 1990 may help identify the nature of the distribution of this compound.

3.3.7 Groundwater Monitoring at the Below-Grade Fuel Storage Area

Table E-2 in Appendix E records the results of groundwater monitoring at well WNW86-13 located near the below-grade gasoline and diesel fuel storage area. These results do not indicate any adverse effects on the groundwater.

3.3.8 Data Comparison to New York State Groundwater Quality Standards

Table 3-1 presents the New York State Groundwater Quality Standards for Class GA waters for the parameters measured by the WVDP groundwater monitoring program. These standards are derived from Title 6 of the New York Code of Rules and Regulations (NYCRR), Chapter X, Part 703.5. Water meeting these standards is acceptable for use as a potable water supply. These standards provide a conservative reference for comparison to site groundwater as site groundwaters are not used to supply on- or off-site potable water. In addition to Table 3-1, the quality standard concentrations are listed at the top of each data column, according to respective parameter, in Tables E-3 through E-14 in Appendix E.

Comparing 1989 site groundwater data to these quality standards reveals the following noteworthy items. For the radiological parameters monitored, both tritium and gross beta concentrations at well WNW86-05 exceeded the respective quality standard. This location, discussed above in Section 3.3.2, is at the immediate downgradient edge of former Lagoon 1. No other radiological parameters measured for waste management unit wells exceeded the appropriate groundwater quality standards. Future comparisons are planned for the beta emitter Sr-90 which has a quality standard lower than that for gross beta activity. Several wells on-site may be above the Sr-90 quality standard but still be below the gross beta quality standard. Note that only well WNW86-05 exceeds the DCG limit of 1.0E-06 μCi/mL for Sr-90 (as indicated by gross beta measurements). Results for pH were marginally lower than the range of 6.5 - 8.5 at groundwater locations WNW86-07, WNW80-06, and WNGSEEP.

Results for sodium and chloride exceeded the quality standard at well WNW86-06 by a significant margin. This is thought to be attributable to operation of the nonradiological sludge ponds.

The above instances in which groundwater quality exceeded standards are believed due, in part, to past and/or present activities at the site. In all cases, the reported concentrations are also significantly different from background concentrations.

Other instances in which groundwater quality standards were exceeded were observed at other locations. However, these are not believed to be directly attributable to site activities. They included elevated levels of some metals, which are believed to be naturally occurring(sodium, iron, and manganese), in both upgradient and downgradient wells. Elevated levels of some other metals (lead, chromium, and cadmium) were observed in unfiltered samples only. Samples filtered and collected at the same time did not confirm the presence of these metals. The cases in which total metals exceeded standards are attributed primarily to the incorporation of sediments and well fines into the unfiltered samples. One well location, WNW86-10, exceeded the pH range of 6.5 - 8.5 on two out of eight measurements. These high pH levels are believed to be due to natural levels and/or technical difficulties in sampling deep, low-yield wells. Finally, although mercury and phenol concentrations have been observed at levels above the groundwater quality standards, analytical results for those samples are in question. For example, two total mercury analyses exceeded the quality standard out of a total of 270 measurements taken. Follow-up sampling and analysis did not indicate any detectable mercury concentrations above the standard, providing further indication that these positive data may not be valid.

3. 3. 9 Off-Site Groundwater Monitoring

During 1989 all of the off-site groundwater residential wells were sampled for radiological contamination, pH, and conductivity. These wells are used by site neighbors as sources of drinking water. There continues to be no evidence indicating contamination of these off-site water supplies by the WVDP. Results for these samples are found in Table C-1.8 in Appendix C.